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ABSTRACT

This paper discusses the role of computer and communication technologies in education. The first section addresses how America, as a nation, envisions the future of technology in K-12 education, including: what the future role of technology in education should be; what the future of education will look like; and the impact of technology on teaching and learning in the near-term and in the long-term. The second section considers how to best realize this vision for the future of education, including: what the nation's goals for the use of technology in education should be; how the nation can achieve the technology goals for the future; and what areas need more attention from the nation. (MES)

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# TECHNOLOGY IN K-12 EDUCATION: ENVISIONING A NEW FUTURE

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U.S. DEPARTMENT OF EDUCATION
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## How Do We Envision The Future Of Technology In K-12 Education?

➢ **What should the future role of technology in education be?**

In his book, *Electric Language: Understanding the Message*, Canadian media theorist, Eric McLuhan said:

> "Animals evolve by incorporating into their bodies new technology, whether by growing longer teeth or by modifying their digestive systems. Human evolution works in the opposite manner. With the first inventions, human evolution suddenly shifted from the realm of biology to that of technology. Animals incorporated; we discorporated. We extended into the environment various parts of the body, various limbs and organs and, with electricity, the central nervous system. Most recently, computer technology and its children now extend around the globe the hemispheres and other elements and organs of the brain. It remains only to extend the mind itself."

Our topic is the role of technology in education, more specifically computer and communication technologies which have combined to create the telematic revolution bursting into virtually every aspect of our homes, workplaces, and schools. By thinking of technologies in the broader sense as extensions of mankind, we give ourselves the capacity to see both the power and the opportunity these new tools afford. Their power comes not just from the fact that technologies allow us to do old jobs in new ways, but that they can be used to help us do things in education that were heretofore impossible. We have the opportunity to use technologies in ways that support modern pedagogical thought devoted to the premise that all are capable of learning, even if the pathways for each learner are different.

This observation leads to two important ideas:

1. How you use technology in education is more important than if you use it at all.

2. Unless our thinking about education is transformed along with our continuing expansion of telematic technology into the classrooms, our technology investment will fail to live up to its potential.

Learning does not take place better or faster simply by replacing one instructional medium with another. The effective use of technology in education requires thought, experimentation, and a

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willingness to spend the time needed to develop and refine strategies until they are proven to be effective. Patience is important; it takes time to see the results of our efforts.

The topic of educational technology is especially important today. Throughout history education has been impacted by three major inventions:

1. the phonetic alphabet
2. printing
3. telematics (computers connected to networks)

While we have had computers in classrooms for many years now, they have yet to be used in ways that assist in radically transforming the very structure of education. But, just as education was transformed by the invention of writing, and again by the invention of the printing press, it will be transformed by the telematic revolution as well. What better time can we imagine to launch this third transformation than the start of a new millennium?

Education serves many purposes in our society and these purposes have changed over the years as we have grown from a cluster of colonies to assume the leadership role in the global economy. Throughout time, the core purpose of education was to insure that our citizens had the skills they needed to actively participate in a democratic society. As Thomas Jefferson said: "I look to the diffusion of light and education as the resource most to be relied on for ameliorating the condition, promoting the virtue, and advancing the happiness of man."

As we complete the twentieth century and prepare for the twenty-first, it is important to realize that our world is far different from the one which existed a hundred years ago. In the 19th century, a largely agrarian workforce existed alongside an emergent industrial economy powered by muscle, water and steam. Since the turn of this century, we have had the flight of airplanes, commercial radio broadcasts, television, the invention of modern computer technologies, the emergence of new sciences (e.g., bioinformatics, chaos and complexity) and a continued rapid increase in the development of new information in a myriad of fields and endeavors.

But while it can be argued that information has been growing at exponential rates since the Middle Ages, the key element of the past fifty years has been the exponential growth of our *access* to this information. The product of information times access has been driven by confluence of modern computer and communication technologies. Information, once scarce, is now abundant. Furthermore, the widespread availability of information has led to the rapid discovery of new information that, in many cases, transforms the value of the things we already know, forcing us to become lifelong learners. The half-life of information seems to be shrinking. While some of the things we learn last forever (literacy, numeracy), other topics change so rapidly that much of what we are taught in school is rendered obsolete by the time we enter the workforce. This is especially true in the sciences and engineering.

An extreme example of the short shelf-life of information can be found in the training requirements for those who will live aboard the International Space Station. The scheduled on-orbit time for a crew on the ISS is 156 days. Several factors contribute to this duration, one of which is that, after this time, the crew no longer has the relevant information needed to continue the mission. And this takes into consideration the just-in-time training which is provided once the crew is on-orbit. The emergence of a continuous learning model contrasts sharply with the traditional notion

that school (learning) is followed by work, which is then followed by retirement. The rapid changes of our era have insured that work and learning will be closely aligned with each other throughout our lives.

In the world of the past where access was limited, information was treated as a scarce resource, and educators had the task of imparting this information for the benefit of learners. We used to live in a world where content was king. That world no longer exists. Content is abundant, and is, therefore, a poor basis on which to base an educational system. What is scarce today is context and meaning. It used to be the mark of an educated person to have a vast reservoir of facts on which to rely. Today this skill is of much less value. The educational system of today needs to impart to all learners three new foundational skills:

1. How to find information.
2. How to determine if what is found is relevant to the task at hand.
3. How to determine if the relevant information is accurate.

These skills were of seemingly less importance in an educational system driven by textbooks. Students would assume (sometimes wrongly) that what was in the textbook was relevant and accurate. This assumption was aided by the fact that students were tested on the material in their textbooks, lending further authority to these sources of information. As for finding information on one's own, this skill was generally not developed in depth unless the learner went to college or graduate school. An unfortunate byproduct of textbook-based education is the tendency of people to accept as true virtually anything they see in print. Since we were taught to accept what was in textbooks as true, even when it wasn't, the transference of implied veracity to other printed documents was a logical byproduct.

Fortunately, if we accept the three skills above as part of the "new basics," we will be providing all learners with valuable skills that will last a lifetime.

Global awareness is also required to participate in the world of the future. As electronic commerce grows in popularity, all ventures have the opportunity to become global in scope. Web sites for companies in the United States can be accessed virtually anywhere in the world, bringing new opportunities to ventures of all sizes. However, in order for these new markets to be reached, it is essential that those working for these companies have the requisite skills to understand the language, culture and history of the countries with whom they are doing business. The Internet brings the entire planet into our grasp, making the understanding of other cultures critically important.

➢ **What will the future of education look like?**

As with schools in the 19th century, those of the 20th century were structured around the idea that time would be constant and learning would be variable. Students were presented with subject matter over a fixed period of 180 days, and then were tested on their ability to master the content in that period of time. While some have argued that 180 days is no longer enough, their calls for a longer school year miss the point. Any fixed period of time will still produce variable results. Some can master certain content quickly, and others need more time. Simply replacing one fixed-time model of education with another is a mistake. After all, if it isn't necessary for everyone to master a

particular subject, then why is it taught? And, if it *is* important, why don't we give learners the time they need to gain mastery? When I fly in a commercial airplane I don't care if my pilot spent six months or six years learning to master flying — all I care is that she achieved excellence before I came aboard.

A system based on fixed time and variable learning is not an educational institution, it is a filtering institution: it separates those who learn quickly from those who do not. Rather than address the needs of each learner, we label some children as "slow learners," and relegate them to the scrap heap of society. While it might be argued that, in the past, those who lacked the capacity to fit into the mold of schooling could still find gainful employment, those days are fast diminishing. Lifelong learning is the norm, and jobs that can be done by those with little education are either being automated out of existence or are being exported to other countries where low-wage jobs still support a viable lifestyle. Meanwhile, jobs requiring high levels of skill are going begging. The average salary of jobs in the information technology sector is $53,000 (compared with an average US salary of $30,000), and yet close to 400,000 of these jobs are vacant because we lack a sufficient number of qualified workers to fill them.

The concept of schools as filters is a product of the Industrial Age, and it has no place in the society of the next century. Twenty-first century schools will provide whatever support is needed to help learners achieve excellence. The idea of school as a fixed-time activity will be replaced by the concept of continuous learning built around a variety of tools and techniques.

In addition to learners being in the physical company of each other with a caring teacher as a guide and instructor, "schools" will reach out to wherever learners are through whatever media make sense at the time — television, radio, e-mail, the web — all these and more can be harnessed in support of an educational system built around the idea that learning should be a constant and time should be a variable. Learners who want to do research in a library at 2:00 AM will be able to access electronic documents from home through the web. Those who want to hear an expert's perspective from another country will be able to take part in a videoconference from their bedrooms or dens. This represents a fundamental shift in thinking from school as a place to school as an activity.

This move from noun (place) to verb (activity) is an essential point to grasp in the redefinition of schooling. It not only conveys the idea that "school" can be in session from a variety of locations and times, but that learning is a process we engage in on a regular basis throughout our lives. Longshoreman and philosopher Eric Hoffer once said:

> "In a time of drastic change it is the learners who inherit the future. The learned usually find themselves equipped to live in a world that no longer exists."

We have clearly entered a world of drastic change, and the shift of school from place to activity is a necessary transformation if our educational institutions are to be relevant in the lives of learners.

Inexpensive compact technologies will have an important role to play in defining schooling. The rapid development of battery-operated computers with wireless access to the web provides just one hint of what lies on the horizon. Devices that today occupy an entire backpack will soon be redesigned to fit comfortably in the palm of the hand, and be priced in the same range as today's portable radios. And, while networked technologies will dominate the future, standalone technologies used for the creation of physical documents will still have their place. The challenge

presented by these new tools is not technological, it is philosophical. There are many twentieth century educators who will resist the shift to the new paradigm. They will need a tremendous amount of staff development to transform their models of teaching to fit the needs of education in the coming years.

The 21st century classroom will be wherever the learner is located — a room at a school, on the bus ride home, in the park, at a museum, or on the playground. Traditional tools (e.g., books, pens and paper,) will co-exist with the high-tech tools of the telematic era that is still in its infancy. The teacher's role in this distributed setting will be quite different from that of content presenter and test giver. A more productive role will be that of co-learner — an expert guide who helps students navigate the subjects being explored, but who is open to new discoveries and pathways along the journey.

The teacher in this setting will operate in a system based on four components: campfires, watering holes, caves, and life. The campfire is the informational space associated with lectures and other methods of direct instruction. The watering hole is the conversational space occupied when learners converse among themselves or with their teachers about a particular topic. The cave is the conceptual space where ideas are developed in relative solitude and where student projects are designed and built. Life is the contextual space where the things that have been learned are applied in the world outside of school. Learning has always taken place in these four spaces, yet twentieth century schools often failed to provide the right balance, and learning suffered as a result.

Traditional schools are designed to facilitate "campfires," lectures given by the teacher. We have learned to use these facilities for moderated conversations (watering holes), but they are ill-suited for reflection and the extended construction of student projects (caves). Their isolation from the world outside the classroom makes context (life) difficult to achieve as well. We can imagine schools looking very different if they had been designed from the beginning as places built around dialog or reflection or contextual application in the real world. The nice thing about telematic technologies is that, unlike physical buildings, they can be applied in all four of these learning spaces with equal ease.

Once these four learning spaces are understood, they provide a framework around which teachers, students, family members and the community at large can envision educational opportunities. The roles of these constituencies in support of learning will vary from community to community, and will change over time within a single community. Flexibility is the key concept for the effective definition of the roles played by different members of the learning community.

- **What impact will technology have on teaching and learning in the near-term? In the long-term?**

  In a 1994 speech (and in others since then), Vice President Gore said:

  "I've often spoken about my vision of a schoolchild in my home town of Carthage, Tennessee being able to come home, turn on her computer and plug into the Library of Congress."

There are several relevant observations to be made about this quote that relate to the effective use of technology in improving educational outcomes for learners. First, the Vice President refers to

the educational activity (perusing the Library of Congress), not to the technology itself. This is an important point. In our rush to bring technology into schools, some have missed the point and talk about student/computer ratios rather than how the technology is being used to accomplish solid educational goals in unique ways. Technology is not the point — learning is. Any educator should be able to explain the curricular and pedagogical objectives of any tool in the classroom, whether it is a book, the blackboard, or a computer connected to the Internet.

Another point made in the quote has to do with access — both to the Library of Congress (whose physical collection is closed to young people) and to rural America (Carthage has a population of about 2,000). One of the great promises of educational technology is that it makes available to all what was once only available to a few. Rare documents that researchers had to schedule appointments to examine have now been digitized and posted on the web for anyone to access at any time. Initiatives like the e-rate are helping to bring affordable broadband connections to schools throughout the country. Rich content and universal access are two important themes when talking about the effective use of technology in education.

Modern technologies are space collapsers, time shifters, and creative tools that extend our reach.

In the pre-wired world, educational resources were largely confined to the community in which the school was located. The Internet eliminates geography as limiting factor. Information can be gleaned from libraries, museums, research centers, and educational institutions all over the world. A child in a remote hamlet can have access to the same reference materials as one located in the most cosmopolitan city. Geography no longer determines whether students will have access to up-to-date information, or if they will have access to topics that are interesting to explore, but might only appeal to a small number of enthusiasts.

Just as geography is transcended by telematic tools, so is time. The Library of Congress and other powerful educational web sites can be explored any time of the day or night, every day of the year. A learner wanting to check out the works of Nathaniel Hawthorne can download his works for free from Project Gutenberg long after the local library has closed for the night.

As our modern learning technologies become more reliable and ubiquitous, they will have an increasingly positive impact on student creativity. The world of book-based learning and ten-page written reports is now augmented by the capacity of students to create multimedia simulations of a topic being studied, rather than being constrained to express mastery solely through the medium of a written report. Access to multiple expressive modalities is important. As Howard Gardner's theory of multiple intelligences has shown, each of us has multiple pathways to learning, only a few of which were valued in the schools of our youth. Today's technologies expand the modes through which students can develop and express their mastery of a subject.

Beyond expanding the breadth and depth of educational resources available to teachers and students, resources such as the Library of Congress' American Memory Project can help stimulate a deeper interest in a subject. Consider, for example, the difference between reading a textbook description of Bell's invention of the telephone, and reading the handwritten letters Bell sent to his fiancé and others as his work was proceeding. His papers, carefully digitized and available through the American Memory Project, reveal the warm human side of this great inventor that is likely to be omitted in a textbook description of his work.

Resources like this not only help learners gain mastery of subject, but also help them develop a deeper relationship with the topic being studied. By placing a human face on academic topics, web-based access to primary source materials can make learning come alive for many students.

Educators are also great beneficiaries of the telematic revolution. In addition to providing access to reference materials on virtually any academic subject, on-line communication tools can help educators collaborate and converse with peers all over the world. Much of the technology needed to do this is in place today — and it will become even more powerful and commonplace in the future. An educator looking for tips on the best way to approach a new topic with students can search for information on the web, take part in a synchronous chat, or post a query to a listserv and wait for a response. The development of inexpensive desktop videoconferencing equipment opens up new opportunities for casual dialogs on a wide range of topics, and helps overcome the sense of isolation sometimes felt by educators whose areas of interest have few local enthusiasts.

In addition to conversing with peers, communication with learners, their parents, and the community at large is facilitated with the same tools. Parents who, for whatever reason, can not attend a student study team meeting at school can take part in this meeting through videoconferencing. This assumes, of course, that the requisite technology is available to parents at home or at some other convenient location. Fortunately, the rapid decline in computer prices is increasing the penetration of Internet-ready computers in homes at almost all income levels.

This view of technology use in education is highly positive, but there are pitfalls as well. One of the most important caveats is to avoid falling through the looking glass. Virtual worlds have their place, but these tools need to be used in service of the physical world in which we all live, work, play and learn.

Just because an educational task can be conducted using technology does not mean it should be. There are many aspects of education for which computers are very poor substitutes for existing methods. No videoconference will be as good as a face-to-face meeting. No portable display device on the market today is as cheap or has the image quality of a printed page. It is a mistake to think that new media displace old ones. People didn't stop painting pictures once the photographic camera was invented. Nothing of value is gained by moving drill and practice from a cheap workbook to an expensive computer screen.

On the other hand, no book can contain an interactive multimedia program, and no pencil can be used to build a student's simulation of an ecosystem. The key idea to keep in mind is that the true power of educational technology comes not from replicating things that can be done in other ways, but when it is used to do things that couldn't be done without it. Word processors are wonderful tools, but they are simply an extension of the typewriter. Multimedia authoring tools, on the other hand, allow the creation of expressive media that was impossible to achieve before computers came to our classrooms. This doesn't mean we should stop using word processors, only that we need to be on the constant lookout for the new things technologies let us do in education — things that were inconceivable in the pre-wired classroom.

## How Can We Best Realize This Vision for the Future of Education?

➢ **What should our goals for the use of technology in education be?**

The current national plan is based on four pillars:

1. Modern computers and learning devices will be accessible to every student.

2. Classrooms will be connected to one another and to the outside world.

3. Educational software will be an integral part of the curriculum.

4. Teachers will be ready to use and teach with technology.

In the years since this plan was created we have made a lot of progress toward these goals, although we have fallen short on widespread achievement. Even though we did not achieve the goals, it is important that we had them because they helped focus our national dialog on the effective use of technology in education. Should we have these goals? Yes. Could we have attained them? Yes. The fact that we fell short says more about the challenges of transforming education than it does about the quality of our objectives.

Now it is time to create a new plan — one for the next five years — a plan that bridges the end of a millennium and the start of a new one. At first blush it would seem appropriate to maintain the same objectives since we still have a lot of progress to make before these goals are achieved. And yet, admirable as these goals are, they are not enough. As this document has tried to show, we need to think of technology in the broader context of redefining public education for the United States. The four pillars of the current plan make no assumptions about changing the structure of education. They leave unasked the questions relating to the relevancy of our current model for schooling. They address only the tools, not the structure of the system.

The new educational technology plan needs to take a broader perspective. If the structure of schooling is antithetical to the learning needs of the coming years, using new tools will do nothing to help the situation.

Marshall McLuhan once said:

> "We look at the present through a rearview mirror. We march backwards into the future."

What he meant by this is that we view all new artifacts through metaphors based on the ones that preceded them. The first automobile was called a "horseless carriage," for example. While this name helped identify the new device, it also hid the fact that there was something far deeper than a horseless carriage hidden in the concept of a motorized vehicle. The modern automobile is a far cry from the old horseless carriage.

We are confronting the same challenge today as we look at the telematic technologies of education. We talk about the web as a library, a museum, a radio or television, and so on. These are just so many "horseless carriages" that obscure the fact that, whatever the web means for education,

it means far more than any one metaphor can describe. Just as horseless carriages were limited by the horse paths they took, educational technologies are limited by the prevailing structure of schooling. The fact that we can look at an engraving of a classroom from the Middle Ages and recognize it as a classroom should shock us. Our current technology plan talks about incorporating telematics into existing schools, with existing schedules, and existing curricula. This tidily avoids having to deal with the deeper issue: Today's schools are based on outmoded paradigms of learning. The crafting of new educational technology goals should take this into account.

First, I would propose that staff development be moved to the number-one position in any dialog on technology in education. Unless effective staff development is in place, the only thing that will change when schools incorporate technology is their electric bill. The staff development should be based not just on knowing how to operate computers — most educators today have computers of their own at home. The staff development needs to focus on the effective use of technology in support of pedagogical and curricular issues appropriate to a redefined concept of schooling.

Another important aspect of staff development is technological fluency. Educators need to know how to use telematic tools for learning so well that they are as natural as books and pencils. One reason this is important is because, even though many students learned how to use computers at home, they generally have not learned how to use them as tools for learning. This requires the guidance of educators or others skilled in this task. Unless all educators have mastered these tools for their own learning, they will be hard-pressed to develop these skills in their students.

Second, preservice education needs to be completely overhauled around the new skills that educators will need to operate in an educational setting appropriate to the next century. According to a Department of Education report, *The Baby Boom Echo: No End in Sight*, teacher retirement and increased enrollment will require the hiring of 2.2 million new teachers in the next decade. If our preservice institutions do not transform their programs, these educators will be prepared to teach in a system that no longer exists. The complete and rapid transformation of preservice education can be facilitated by changing the criteria through which accreditation is offered. Institutions that fail to meet the new criterial will lose their accreditation.

Third, we need a goal that states the need for every learner and educator to master three fundamental skills mentioned before for the effective use of the web: knowing how to find information, how to determine its relevance, and how to determine its accuracy. If this skill can be applied to web-based information, it can be applied to information in any form. These are foundational skills for everyone in the coming years and they need to be mandated. (For example, they would be foundational skills taught in both preservice and inservice education for all teachers.)

Fourth, we need to redouble our efforts to insure that every learner has universal access to telematic learning tools. As described later in this document, the digital divide is widening. I know of no faster way for the United States to collapse into a third world economy than to allow this trend to continue.

Fifth, we need to continue and expand projects that bring rich educational materials in the public domain to all. The American Memory Project of the Library of Congress is but one exemplary example, as is the work of NASA and other governmental resources. The continuation and expansion of projects like FREE (http://www.ed.gov/free) will contribute to this effort. In developing these resources, it is essential to link our efforts with those of other countries to help build awareness and understanding of other cultures to all our learners.

Above all, we need to acknowledge that technology use, per se, is not the point. How technology is used is more important than if it is used at all. Toward this end, deep structural changes in education can be supported with technology use as we make the shift from "learning about" to "learning by doing," from reception to construction of knowledge, from institutions to learning communities, and all the other transformations required of 21st century society.

Whatever goals we choose, they should be visionary. As Gil Noble once said, "The biggest enemy of excellence is 'good enough'." If we expect excellence from our learners, we need to expect it from our teachers and institutions as well.

- **How can we, as a nation, achieve the technology goals for the future?**

In a letter to James Madison in 1787, Thomas Jefferson wrote:

> "I hold it, that a little rebellion, now and then, is a good thing, and as necessary in the political world as storms in the physical."

In education, the time for a "little rebellion" is at hand. We must continue to develop bold visions for the future built on an understanding that the future will not be an extrapolation of the past. We must recognize that our institutions must serve the society in which they exist.

The United States of the twenty-first century will be very different from what it was in the nineteenth century when our current model of schooling reached full flower. Unless we change our schools to meet the needs of the new century, they will cease to be relevant in the education of our youth and will be replaced by those who can not afford to preserve the status quo in a highly competitive global economy moving at Internet speed.

The role of the Federal government should be to help the American public understand the need for a deep systemic transformation of our educational system. For many years we have been telling the public that education needs to be changed, but much of this conversation has focused on the need to achieve better results in student learning without addressing the deeper structural and systemic issues that define our schools. Unless we aggressively work to transform the very structure of schooling, all our efforts to improve student performance will fall short. The educational system of today was never designed to educate the entire populace to high levels of mastery. It was not designed to be flexible enough to adapt to a world moving at today's pace. It is, in fact, a miracle that our schools have done as well as they have. The fundamental structure of schooling is almost antithetical to the learning needs of the next century. We should not be surprised that we are doing poorly; we should be impressed that we have done so well.

We need a "little rebellion". We need to engage all stakeholders in our communities in conversations about education and learning in general. We need to understand that everyone at any age is at least a part-time learner, and explore ways that the learning needs of our communities can best be addressed. Diverse perspectives will be presented, and all should be heard, but the fundamental question remains the same: "What should educational institutions be like if they are to meet the learning needs of those who will live and work in the twenty-first century?"

The Federal government can play a significant role in keeping this question in the public's mind, in funding projects in support of this transformation, and in encouraging communities to take a leadership role in preparing all learners for the coming years.

The main message to be conveyed is simply this: *We must prepare learners for their future, not for our past.*

This task will be hard to achieve. Schooling is one of the few activities that every citizen experiences. As a result, we each have a vision of what school is like, based on our own experiences. Understanding that this comfortable recollection from our youth describes a system that met the needs of a very different time is hard. Many will claim that we need to go back to some romanticized notion of "basic education," and that our problems would all be solved if we just stopped "messing" with the system. Preservice instructors will have to completely transform their curriculum and teaching methods. The design of new schools will need to reflect the new model of education needed to prepare young people for their dynamic future. The fact is that the world outside of school has changed so much as to be largely unrecognizable to our grandparents, yet many persist in the belief that we can keep our schools the same and still help learners acquire the new skills they need for a world moving at light speed.

One definition of insanity is to keep doing the same thing while expecting different results. The only way we will address the needs of today's youth is to be agressive in transforming our educational system to meet the needs of the next century.

In other words, our challenge will be to help the public understand that *when you travel at the speed of light, you don't need a rearview mirror.*

➢ **What else should we, as a nation, be paying more attention to that we are not?**

The vision presented in this document is (I hope) far-reaching, but it is likely to be meaningless unless we address the very severe inequities in technology access that exist today. In the most recent (1999) release of *Falling Through the Net: Defining the Digital Divide*, a document from the National Telecommunications and Information Administration (http://www.ntia.doc.gov), some sobering statistics show just how great the challenge has become:

- Households with incomes of $75,000 and higher are more than twenty times more likely to have access to the Internet than those at the lowest income levels, and more than nine times as likely to have a computer at home.

- Whites are more likely to have access to the Internet from home than Blacks or Hispanics have from any location.

- Black and Hispanic households are approximately one-third as likely to have home Internet access as households of Asian/Pacific Islander descent, and roughly two-fifths as likely as White households.

- Regardless of income level, Americans living in rural areas are lagging behind in Internet access. Indeed, at the lowest income levels, those in urban areas are more than twice as likely to have Internet access than those earning the same income in rural areas. For

many groups, the digital divide has widened as the information "haves" outpace the "have nots" in gaining access to electronic resources.

- The gaps between White and Hispanic households, and between White and Black households, are now more than six percentage points larger than they were in 1994.
- The digital divides based on education and income level have also increased in the last year alone. Between 1997 and 1998, the divide between those at the highest and lowest education levels increased 25 percent, and the divide between those at the highest and lowest income levels grew 29 percent.

None of this is meant to suggest that the increase in access by highly educated, affluent citizens is bad — on the contrary, it is wonderful. The problem is that access among the poor, minorities, and citizens in rural America is not growing as rapidly, further widening the gap between the information haves and information have-nots. Until every home can afford access to information resources, we will need public policies and private initiatives to expand affordable access to those resources.

Beyond that, it is important to understand the role schools can play in addressing inequities. America's schools reach all young people, rich, poor, people of color, those who live in rural areas — everyone. If our schools are equipped with the modern technologies of information and communication, they can serve as resources not just to our children, but to the community at large. This expanded role of schools as community access centers also fits with the reality that we have entered an era where lifelong learning is a necessity, not a luxury. Schools available to all, open day and night, can become the common meeting ground for communities — places where we see the power of a democratic society in action. What better force can one imagine to bring people together in pursuit of the continued development of our free society than such places? Schools where young and old can learn, places where ideas can be shared, leverage points for economic development — all these and more become possible when we re-envision schools as active wired community access points to the entire planet. A technology plan connected to the redefinition of schooling is a wonderful gift for this millenium to provide to the next.

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David has received numerous awards for his work, including being elected one of twenty "Pioneers in Educational Technology" by ISTE, and being the recipient of the Golden and Platinum Disk Awards from Computer Using Educators.

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Prior to working in education, David was one of the first members of the Xerox Palo Alto Research Center and the co-founder of two small companies in Silicon Valley. He currently splits his residence between San Francisco, California and Recife, Brazil.